Textos para Discussão 003 | 2012
Discussion Paper 003 | 2012

Price Stability under Inflation Targeting in Brazil: an empirical analysis of the monetary policy transmission mechanism based on a VAR model (2000-2008)

André de Melo Modenesi
Institute of Economics, Federal University of Rio de Janeiro (UFRJ)

Eliane Cristina de Araújo
State University of Maringá (UEM).

Price Stability under Inflation Targeting in Brazil: an empirical analysis of the monetary policy transmission mechanism based on a VAR model (2000-2008)[♣]

Setembro, 2012

André de Melo Modenesi
Associate professor in the Institute of Economics at Federal University of Rio de Janeiro (UFRJ), researcher of the National Council for Scientific and Technological Development (CNPq) and Director of Brazilian Keynesian Association (AKB).

Eliane Cristina de Araújo
Associate professor at the State University of Maringá (UEM).

[♣] Our special thanks to Rui Lyrio Modenesi, Thomas Palley, Gary Dymski, Leonardo Oliveira, Manoel C. Pires and Carolina Dias. Any errors or omissions are our own. Earlier versions of this paper were presented at the *2nd Brazilian Keynesian Association Conference* (August, 2009), at the *38th Brazilian Meeting of Economics* held by ANPEC (December, 2010) and at the *8th International Conference Developments in Economic Theory and Policy* (June, 2011). This paper results from a research project developed by the authors with financial support from the National Research Council (CNPq).

Abstract

With a view to offer a body of empirical evidence to assess the costs and benefits of Brazilian stabilization policy, we undertake an econometric analysis of the transmission mechanism of monetary policy in Brazil during the period from the adoption of inflation targeting regime (IT) to the subprime crisis (2000-2008). Exchange rate was the main channel of monetary policy transmission during that time frame. Furthermore, inflation sensitivity to the interest rate is low. Thus, a raise in the basic interest rate (Selic) generates relatively small benefits (a fall in inflation). However, an interest rate increase generates substantial costs: a slowdown in economic activity, the appreciation of exchange rate and an increase in public debt. Inflation's low sensitivity to interest rates is seen as a result of problems in the transmission mechanism: a broken transmission mechanism reduces the efficiency of monetary policy. Price stability under IT thus requires an excessively rigid monetary policy. The final outcome is, on the one hand, that inflation hardly gives in. On the other hand, the costs of high interest rates escalate. We conclude that the balance of costs and benefits of price stability under IT is unfavorable.

Keywords: Inflation; Monetary Policy Transmission Mechanism; Selic Rate

JEL Classification: E40, E52, E31.

Resumen

Con el objetivo de producir uno cuerpo de evidencias empíricas que posibiliten evaluar los costos e beneficios de la política brasileña de estabilización hemos hecho una análisis econométrica del mecanismo de transmisión de la política monetaria desde la adopción del régimen de metas de inflación (MI) hasta la crisis de la *subprime* (2000-2008). La tasa de cambio ha sido el principal canal de transmisión. Además, es baja la sensibilidad de la inflación con respecto a la tasa básica de interés (Selic). Así que una elevación de la Selic genera beneficios (la caída de la inflación) relativamente pequeños. Sin embargo, un aumento en la Selic tiene costos substanciales: la reducción de la actividad económica, la apreciación cambial e un incremento en la deuda pública. La baja sensibilidad de la inflación con respecto a la tasa de interés es interpretada como resultante de problemas en el mecanismo de transmisión: imperfecciones en la transmisión reducen la eficiencia de la política monetaria. La estabilidad de precios, bajo el MI, requiere una política monetaria demasiadamente rígida. El resultado final es, por uno lado, que la inflación difícilmente cede. Por otro lado, el costo de la alta tasa de interés es intensificado. La conclusión es que es desfavorable el balance entre los costos e beneficios de la política monetaria.

Palabras-chave: Inflación; Mecanismo de Transmisión de la Política Monetaria; Tasa Selic

JEL Classification: E40, E52, E31.

1 Introduction

In an inflation targeting regime (IT), the basic interest rate is the main instrument to control inflation. In fact, ever since IT was adopted in mid-1999, the basic interest rate (Selic[i]) has been the *sole* instrument used to ensure price stability in Brazil. It worth to mention that this is not a critique paper on the theoretical foundations and operational procedures of that monetary regime, although a lot could be said about those issues (see Modenesi, 2005; Vernengo, 2008; Haight, 2008; and Epstein and Yeldan, 2009; among many others). The purpose of this paper is to offer a body of empirical evidence to support the assessment of the main costs and benefits arising from the current stabilization policy in Brazil. That shall be accomplished by undertaking an empirical analysis of how variations in Selic affect or are transmitted to the main macroeconomic variables, namely: inflation, exchange rate and economic activity.

On the one hand, an increase in the basic interest rate reduces inflation; as stressed by IT advocates, price stability promotes efficiency, from which the whole functioning of the economic system will benefit – and thus contribute to boost economic growth. On the other hand, an increase in interest rates contributes to slow down the economy, to appreciate the domestic currency and to increase public debt. Hence, a raise in interest rates jeopardizes economic performance.

With the purpose of identifying and assessing the costs and benefits of the monetary policy practiced in Brazil for nearly a decade, we shall undertake an empirical analysis of the transmission mechanism, defined as the process through which variations in the basic interest rate affect the general price level. The *sacrifices* imposed by stabilization policy, conceived as the social and economic costs resulting from an increase in interest rates, will be evidenced by using a Vector Autoregression (VAR) model.

Traditionally, that kind of exercise is made by estimating the so called “sacrifice ratio”, or the ratio of the output loss (deviation of real GDP from its potential) to the associated changes in inflation.[ii] The present study addresses this issue in a broader sense than usual, as it focuses on the concurrence of three detrimental effects of an increase in the basic interest rate: the slowdown in economic activity, the appreciation of the domestic currency and the expansion of public debt. Econometric analysis will allow us to systematize and quantify the main negative outcomes of an increase in Selic, as well as its impact on inflation. Thus, we will be able to compare the effect of variations in Selic on prices in face of its detrimental effects on exchange rate, economic activity and public debt.

This article is divided in three sections, in addition to this introduction and a conclusion. Next section states that in IT regime the monetary authority sustains an institutional commitment to make price stability the main long-term goal of monetary policy. In the third section, the VAR model is presented. Section four analyzes the transmission mechanism of monetary policy, stressing the interactions between the basic interest rate (Selic), inflation (as measured by the consumer price index, IPCA), the exchange rate, the level of economic activity (using industrial output as a proxy), and public debt (measured by the debt/GDP ratio). The empirical evidence corroborates the – already widespread – thesis that Brazil's monetary policy has taken a high cost on the country's economy. In short, we will provide a body of significant empirical evidence showing that Brazil's monetary policy under IT, besides having little effect on inflation control, has imposed a high level of sacrifice.

2 Inflation Targeting: the Emphasis on Price Stability

From an operational standpoint, IT is a monetary regime marked by an institutional commitment by the monetary authority to adopt price stability as the main long-term goal of monetary policy – to which all the remaining objectives are subjected.[iii] IT is characterized by: i) setting a medium-term inflation target; ii) reduced importance of intermediate targets, such as, for instance, monetary aggregates; iii) greater transparency in the conduct of monetary policy, substantiated in the efforts to improve communication between the Central Bank (CB) and economic agents, allowing for a greater accountability of CB; iv) independence of CB instruments (Fischer, 1995) or greater ability to carry out its targets – that is, it is required that the CB be free to determine monetary policy instruments.[iv]

IT had a sort of *golden age* from its first adoption by New Zealand in 1990 to the 2008 subprime crisis. According to the so called *New Consensus Macroeconomics*, IT is *the correct* way of monetary policy-making, in a way that such regime has been adopted globally. However, as one of the aftermaths of the subprime crisis in 2008, central banks' blind faith on IT has been substantially reduced. At the same time, we have witnessed a shy movement by orthodox theory towards the recognition that monetary policy should target other variables than inflation. For instance, Blanchard *et al*. (2010) and Eichengreen *et al*. (2011) consider that monetary policy should also target asset prices – in order to prevent financial crisis.

This late orthodox criticism reinforces a general criticism shared by many heterodox economists. From a theoretical standpoint, most of IT critics rightfully emphasizes that the adoption of IT implies the acceptance of long-run money neutrality – resulting from the assumption of the natural rate of unemployment hypothesis (Friedman, 1968). From a more operational perspective there is plenty of criticism on: i) the use of a *single* instrument (the interest rate) to curb inflationary pressures;[v] and ii) the belief that any rise (fall) in inflation should always be followed by a rise (fall) in interest rates, regardless of the nature of the inflation – aligned with the Taylor rule.[vi]

Those who advocate IT generally justify the emphasis given to price stability on the grounds of an alleged *consensus* against the use of discretionary monetary policies, with the purpose of reducing unemployment, as proposed by Keynesian macroeconomic tradition, according to which money is not neutral in the long run. There are three paradigmatic moments in the challenge to monetary policy discretion: i) evidence of lags in monetary policy transmission – reported by Friedman (1948); ii) denial of the existence of a long-run trade-off between inflation and unemployment – originally proposed by Friedman (1956, 1968) and Phelps (1967, 1968) and furthered by Lucas (1972, 1973), Sargent (1981) and Sargent and Wallace (1981a, 1981b); and iii) development of the time-inconsistency problem and the resulting *inflation bias*, by Kydland and Prescott (1977), Calvo (1978) and Barro and Gordon (1983a, 1983b).[vii]

Historically, the costs of inflation – as well as the channels through which inflation reduces the level of utility of economic agents and, thus, of social welfare – has been a recurrent theme in orthodox monetary theory. Such literature, which we do not intend to review here, is extremely vast, since its origins date back to the mercantile period. Contemporarily, one could highlight Bailey's contribution (1956) in defining the loss of social welfare to inflation as the consumer surplus that would be generated were the nominal interest rate brought down to zero. Inspired by Bailey (1956), Lucas (2000) argued, regarding the American economy, that "the gain from reducing the annual inflation rate from 10 percent to zero is equivalent to an increase in real income of slightly less than one percent".[viii]

In accordance with that literature, the following inflation-related issues are worth to mention: i) the super-sizing of the financial system; ii) the economy vulnerability to financial crises – due to the greater fragility of its financial system (compared to economies with stable prices); iii) the deterioration of the tax system – since taxes are usually not indexed –, bringing on several negative consequences such as the *Tanzi*[ix] effect; iv) the occurrence of distributive effects, since indexation mechanisms do not fully protect the income of the different economic groups; v) menu costs from changing prices; and vi) market failures and ineffective resource allocation – due to imperfect signaling of the price system –, which in turn decreases the productivity of production factors and, thus, jeopardizes economic growth.

Among those issues, the latter is particularly relevant, given that it supports the idea that price stability is a necessary condition for economic growth: "As a great deal of prior theory predicts, the results presented here [for the US economy] imply that inflation reduces growth by reducing investment, and by reducing the rate of proclivity growth" (Fischer, 1993: 22).

Bernanke *et al.* (1999) also stress that inflation decreases economic efficiency, jeopardizing economic growth. According to them, price stability is, thus, a necessary condition for the achievement of other macroeconomic goals, such as high GDP growth and low unemployment. That is one of the main reasons for adopting IT, which, the authors state, could also be justified on the grounds that: i) the inflation target works as a nominal anchor; and ii) money is neutral in the long run. In their words: "[...] there is by now something of a consensus that even moderate rates of inflation are harmful to economic efficiency and growth, and that the maintenance of a low and stable inflation rate is important, perhaps necessary, for achieving other macroeconomic goals" (Bernanke *et al.*, 1999: 10).

The belief that reduced levels of inflation are a fundamental precondition for sustained economic growth is widely spread. According to that belief – which we do not intend to question herein –, price stability is an absolute priority.[x] The fact that Brazil has experienced a long period of chronic high inflation contributes to the almost unconditional acceptance of that belief by great part of the Academy and a great number of opinion-makers. Thus, little attention has been given to the costs arising from fighting inflation (Epstein, 2003).[xi] And that is precisely one of the contributions of this article: to draw attention to the main costs of the current price stabilization policy.

It is not our intention here to address, from a theoretical standpoint, the process through which a raise in the basic interest rate generates social and economic costs – and thus reduces welfare. This mechanism – which finds ample support in economic theory – will be summarized in simple terms as follows. A raise in interest rates: i) discourages private investment, reducing aggregate demand and thus reducing the GDP growth rate; ii) by making financial assets denominated in domestic currency more attractive, it impacts positively on the capital account, causing the domestic currency to appreciate and therefore the competitiveness of domestic output to reduce – which, in turn, deteriorates the balance of payments; and iii) increases debt-servicing expenditure, raising public debt.[xii]

For the three reasons previously mentioned, we argue that a raise in the basic interest rate imposes a cost on society. It is worth taking into consideration that this paper in no way intends to explore all the potential negative impacts of a raise in the basic interest rate. For instance, monetary policy may produce perverse distributive effects (Areosa and Areosa, 2006).[xiii] Nevetheless, for the purpose of this article, the three previously mentioned effects are sufficient.

In short, the adoption of IT is, to a great extent, grounded on the belief that inflation is highly detrimental to economic growth and thus price stability becomes the main objective to be attained by monetary policy.[xiv] However, little importance is given to the costs of achieving and/or maintaining price stability. Orthodox theory tends to amplify the relevance of inflation costs. However, even if one takes for granted that inflation is detrimental, the net impact on social welfare of a raise in interest rates remains, in principle, undefined.

The balance of costs and benefits related to inflation control depends on the actual manner through which the effects of interest rate movements are transmitted to the remaining macroeconomic variables. A broken transmission mechanism may produce an unfavorable balance of costs and benefits in monetary policy. In other words, the more sensitive inflation is to interest rates, the less rigid will monetary policy need to be in order to ensure the achievement of a given inflation target. Alternatively, transmission flaws may reduce inflation's sensitivity to interest rates and, consequently, will jeopardize the efficiency of monetary policy to control inflation. As a result, and aligned to IT framework, it becomes *necessary* to apply relatively higher doses of interest rates to ensure stability. In that case, the costs arising from the policy tend to escalate. Thus, an evaluation of the current stabilization policy must be based on an empirical analysis of the transmission mechanism of monetary policy. We shall do that in next section.

3 Empirical Evidence

3.1 Database and Unit Root Tests

The implementation of IT in Brazil, on June 21, 1999, represented a significant shift in the monetary regime, as well as a deep change in the conduct of monetary policy, which until then had been based on an exchange rate targeting (Modenesi, 2005: chap. 5 and 6). As a result, to enhance robustness, we excluded the first six months of IT adoption from our sample, which therefore covers the period from January 2000 to August 2008. The subprime crises after the falling down of Lehman Brothers (September, 1998) represents a major structural break. After that, the conduct of monetary policy has changed deeply worldwide – for instance, with the adoption of the so called quantitative easing program by FED – and we have seen an *abnormal* decline of the main Central Banks' rates (FED, BOE, ECB, BOJ). So we have decided to limit our sample to the pre-subprime crisis period, which includes 104 monthly observations and thus grants robustness to our results.

The list of variables to be applied is as follows: *Selic* is the basic interest rate (p.y.); *IPCA* is the consumer price index; *Ind* is the index of physical output (*quantum*) of the domestic industries (seasonal adjustments apply); *Exchange* is the (monthly average) nominal exchange rate (real/USD); and *Div* is the public debt as a proportion of GDP.

Brazilian Central Bank (BCB) provides the Selic rate and the exchange rate, whereas the Brazilian Institute of Geography and Statistics (IBGE) provides the index of industrial output and also IPCA. The public debt stock is provided by the National Treasury. As for the debt/GDP ratio, it is the authors' calculation. To all variables the logarithmic scale applies – for instance, the term *Selic* always refers to the *Selic* Neperian logarithm (*logSelic*).

In order to determine whether the variables follow a stationary process, the augmented Dickey-Fuller test (ADF) and the Phillips-Perron (PP) test were carried out in the series at the level and its first difference (Tables 1 and 2).[xv] The null hypothesis of a unit root (non-stationary) is not rejected for all variables at the 1% level.

Table 1 – Augmented Dickey-Fuller Test (ADF): level and first difference

Variable	Lags	*T* statistics	Critic value: 1%	5%	10%
Selic	1	-3.0560	-4.0505	-3.4544	-3.1529
IPCA	0	-1.1834	-4.0505	-3.4544	-3.1529
Exchange	1	-1.6303	-4.0505	-3.4544	-3.1529
Ind	0	-2.4792	-4.0505	-3.4544	-3.1529
Debt	0	-2.1539	-4.0505	-3.4544	-3.1529
DSelic	0	-3.2368	-4.0505	-3.4544	-3.1529
DIPCA	0	-4.7657	-4.0505	-3.4544	-3.1529
DExchange	0	-7.4262	-4.0505	-3.4544	-3.1529
DInd	0	-11.406	-4.0505	-3.4544	-3.1529
DDebt	0	-11.035	-4.0505	-3.4544	-3.1529

Note: ADF at level with trend and intercept.

However, the null hypothesis is rejected for all variables at first difference (at the usual levels of significance). Thus we may conclude that the series are integrated of order 1, *I(1)*.

Table 2 – Phillip-Perron Test (PP): level and first difference

Variable	Lags	*T* statistics	Critic value: 1%	5%	10%
Selic	1	-1.9729	-4.0495	-3.4540	-3.1526
IPCA	0	-0.8097	-4.0495	-3.4540	-3.1526
Exchange	5	-1.3849	-4.0505	-3.4544	-3.1529
Ind	4	-2.3582	-4.0505	-3.4544	-3.1529
Debt	5	-2.8094	-4.0505	-3.4544	-3.1529
DSelic	0	-3.2368	-4.0505	-3.4544	-3.1529
DIPCA	0	-4.7419	-4.0505	-3.4544	-3.1529
DExchange	4	-7.4553	-4.0505	-3.4544	-3.1529
DInd	12	-12.110	-4.0505	-3.4544	-3.1529
DDebt	4	-10.996	-4.0505	-3.4544	-3.1529

Note: PP at level with trend and intercept.

3.2 Cointegration

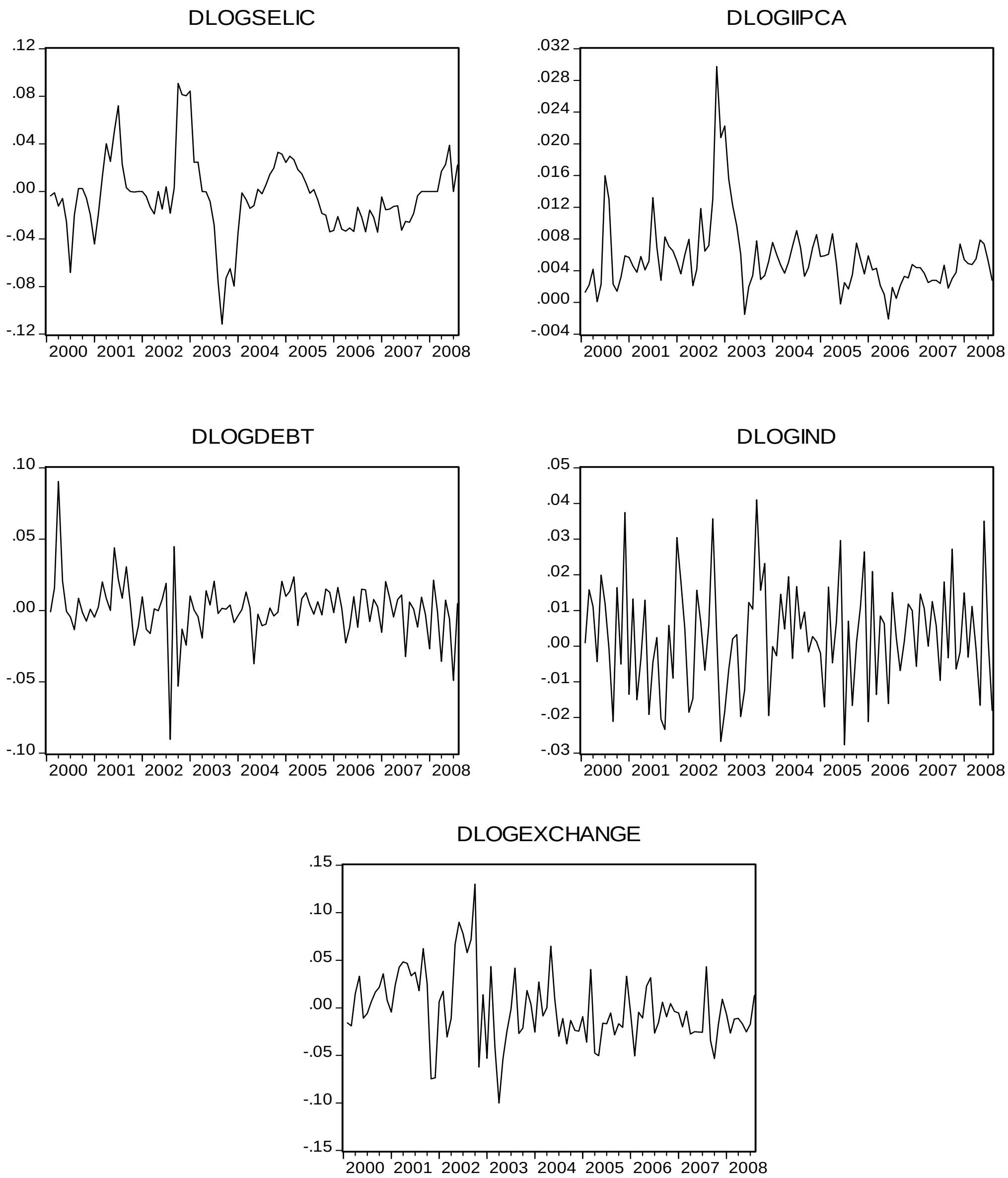
Having determined that the series are non-stationary and *I(1)*, two cointegration tests shall be performed. The null hypothesis (no cointegration relationship) is not rejected at the 5% significance level, neither for trace statistics, nor for maximum eigenvalue statistics (Table 3).

Table 3 – Cointegration Tests

	Trace statistics			Max-Eigen statistics		
	Eigen value	Critical value	Prob. 5%	Eigen value	Critical value	Prob. 5%
None	6.001.641	6.006.141	0.0504	2.436.238	3.043.961	0.2363
At most 1	3.565.403	4.017.493	0.1326	1.785.088	2.415.921	0.2830
At most 2	1.780.315	2.427.596	0.2626	1.034.641	1.779.730	0.4494

Given the strong evidence indicating the non-existence of a cointegrating vector, and given that the series are *I(1)*, we will estimate a VAR model for the series at first difference. Figure 1 shows the variables at first difference and allows the series behavior to be visualized.

Figure 1 – *DSelic, DIPCA*, *DInd*, *DDebt* and *DExchange*: 2000/Jan. to 2008/Aug.



3.3 Estimation: Lag Order Selection and Granger Causality

To determine the number of lags to be included in the model, the usual tests apply. The *SC* and *HQ* information criteria suggest only one lag, as shown in Table 4. The *LR*, *FPE* and *AIC* criteria suggest the inclusion of three lags.

Table 4 – VAR Lag Order Selection Criteria

lags	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	1274.098	NA	1.71e-18	-2.671.785	-2.658.343	-2.666.353
1	1385.360	208.4707	2.79e-19	-2.853.390	-27.72741*	-28.20802*
2	1410.061	43.68213	2.82e-19	-2.852.761	-2.704.905	-2.793.016
3	1436.245	43.54774*	2.78e-19*	-28.55253*	-2.640.190	-2.768.351
4	1458.594	34.81755	3.00e-19	-2.849.672	-2.567.402	-2.735.614
5	1483.176	35.70770	3.14e-19	-2.848.791	-2.499.313	-2.707.576
6	1506.104	30.89307	3.45e-19	-2.844.430	-2.427.745	-2.676.058

The VAR models with one or three lags show residuals that are strongly autocorrelated, heteroscedastic and non Gaussian. To avoid that problem, a successively larger number of lags was introduced, until a model with *well behaved* residuals could be obtained. Finally, we decided to estimate the model with six lags, therefore satisfying the basic conditions of robustness (see next item), according to equations 1-5:[xvi]

$$DlogSelic_t = \alpha_{10} + \alpha_{11}DlogIPCA_{t-1} + \alpha_{12}DlogInd_{t-1} + \alpha_{13}DlogDebt_{t-1} + \alpha_{14}DlogExchange_{t-1} + \varepsilon_{t-1} \quad (1)$$

$$DlogIPCA_t = \alpha_{20} + \alpha_{21}DlogSelic_{t-1} + \alpha_{22}DlogInd_{t-1} + \alpha_{23}DlogDebt_{t-1} + \alpha_{24}DlogExchange_{t-1} + \varepsilon_{t-1} \quad (2)$$

$$DlogInd_t = \alpha_{30} + \alpha_{31}DlogSelic_{t-1} + \alpha_{32}DlogIPCA_{t-1} + \alpha_{33}DlogDebt_{t-1} + \alpha_{34}DlogExchange_{t-1} + \varepsilon_{t-1} \quad (3)$$

$$DlogDebt_t = \alpha_{40} + \alpha_{41}DlogSelic_{t-1} + \alpha_{42}DlogIPCA_{t-1} + \alpha_{43}DlogInd_{t-1} + \alpha_{44}DlogExchange_{t-1} + \varepsilon_{t-1} \quad (4)$$

$$DlogExchange_t = \alpha_{50} + \alpha_{51}DlogSelic_{t-1} + \alpha_{52}DlogIPCA_{t-1} + \alpha_{53}DlogInd_{t-1} + \alpha_{54}DlogDebt_{t-1} + \varepsilon_{t-1} \quad (5)$$

Where: i = 1, 2, 3, 4, 5, 6; D indicates the first difference; and $\varepsilon \sim (0, \sigma^2)$.[xvii]

Table 5 shows the results from the Granger causality test performed to check if a given variable temporally precedes – or causes, in the *Granger sense* – another.

Table 5 – Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Probability
DIPCA does not Granger Cause *DSelic*	100	1.37575	0.25508
DSelic does not Granger Cause *DIPCA*		2.58356	0.05797
DInd does not Granger Cause *DSelic*	100	3.01592	0.03386
DSelic does not Granger Cause *DInd*		4.18677	0.00794
DDebt does not Granger Cause *DSelic*	100	5.35645	0.00190
DSelic does not Granger Cause *DDebt*		0.32906	0.80434
DExchange does not Granger Cause *DSelic*	100	3.69121	0.01464
DSelic does not Granger Cause *DExchange*		0.72581	0.53911
DInd does not Granger Cause *DIPCA*	100	0.29639	0.82792
DIPCA does not Granger Cause *DInd*		2.63378	0.05446
DDebt does not Granger Cause *DIPCA*	100	1.91775	0.13209
DIPCA does not Granger Cause *DDebt*		4.90880	0.00328
DExchange does not Granger Cause *DIPCA*	100	9.20958	2.1E-05
DIPCA does not Granger Cause *DExchange*		0.81421	0.48919
DDebt does not Granger Cause *DInd*	100	0.13587	0.93840
DInd does not Granger Cause *DDebt*		1.32037	0.27249
DExchange does not Granger Cause *DInd*	100	0.66098	0.57811
DInd does not Granger Cause *DExchange*		0.40047	0.75298
DExchange does not Granger Cause *DDebt*	100	1.76989	0.15832
DDebt does not Granger Cause *DExchange*		6.45619	0.00051

One should note that there is strong evidence that *DExchange* causes, in the Granger sense, *DIPCA* (at the 1% significance level). Also, there is evidence that *DExchange* causes, in the Granger sense, *DSelic* (at the 1% level). It should also be stressed that *DSelic* causes, in the Granger sense, *DInd* (1%). Finally, one should mention that the evidence also shows that *DSelic* causes, in the Granger sense, *DIPCA* at the 10% significance level. Next section explores these findings.

3.4 Robustness Tests

The usual robustness tests were applied. Initially, we checked for autocorrelation in the model's residuals. There is no evidence to reject the null hypothesis (non existence of serial autocorrelation) after the inclusion of the third lag in the model (Table 6).

Table 6 – VAR Residual Serial Correlation LM

Lags	LM-Stat	Prob.
1	47.54057	0.0042
2	56.27419	0.0003
3	31.96744	0.1590
4	24.29755	0.5022
5	31.89766	0.1610
6	23.44589	0.5515

Table 7 highlights the evidence against the rejection of the null hypothesis that residuals are homoscedastic, indicating heteroscedasticity to be non-existent.

Table 7 – VAR Residual Heteroskedasticity Tests (Joint test)

Chi-sq	DF	Prob.
9.011.952	900	0.4825

The Jarque-Bera normality test suggests the rejection of the hypothesis that errors follow a normal distribution (Table 8). However, that problem can be minimized on the grounds of the Central Limit Theorem.[xviii]

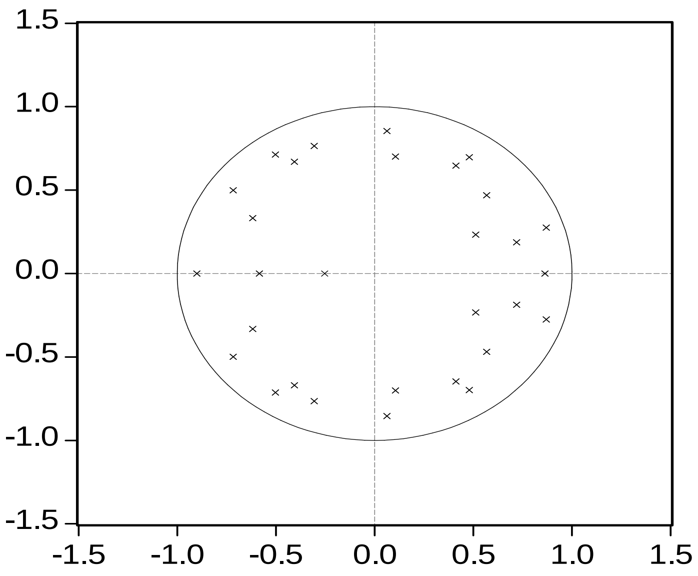
Table 8 – VAR Residual Normality Tests (Jarque-Bera)

Component	Jarque-Bera	Prob.
1	10.79051	0.0045
2	8.316471	0.0156
3	11.50875	0.0032
4	10.27291	0.0059
5	9.521215	0.0086
Joint	**50.40986**	**0.0000**

Note: 6 lags; 97 observations

Finally, we checked for the model's stability. According to figure 2, all inverse roots of AR characteristic polynomial lie inside the unit circle, meaning that the VAR system is stable.

Figure 2 – Inverse Roots of AR Characteristic Polynomial



In short, robustness tests indicate that in the estimated model (with six lags) residuals are non-correlated and homoscedastic, despite not being normal.

4 The Relationship between Interest Rate, Exchange Rate, Inflation, Output and Public Debt in Brazil: an Empirical Analysis of the Monetary Policy Transmission Mechanism

The estimated model allows us to analyze the interaction between five macroeconomic variables of vital importance. By establishing bilateral relations between all variables, the VAR model is proven suitable to our goals. The intuition behind variable selection is simple.

On the one hand, economic theory shows that the series used herein are related – in some cases the relationship is mutual, in others bilateral, and so on. For instance, a raise in interest rates prompts: i) a decrease in inflation; ii) a slowdown in economic activity; iii) an appreciation of domestic currency; and iv) a raise in public debt. Accordingly, it is reasonable to consider that an exchange rate devaluation: i) is transferred into domestic prices; ii) impacts on public debt, due to the existence of exchange rate indexed bonds;[xix] etc. As a conclusion, according to economic theory, the variables in the model are bounded to be widely interrelated.

On the other hand, in accordance with the Taylor rule, BCB reacts to inflation and output levels by setting the basic interest rate.[xx] Apart from that, it is reasonable to consider that BCB's reaction function can be widened by including the exchange rate and the debt/GDP relation. Many authors have included the exchange rate on their Taylor rule's estimates. Additionally, the importance given to the exchange rate by BCB's Monetary Policy Committee (COPOM) justifies the inclusion of such variable. According to the COPOM meeting proceedings, Selic is fixed taking a given exchange rate level as a parameter. In other words, BCB reacts to the exchange rate when setting the basic interest rate: depreciation is expected to make BCB raise the basic interest rate with the purpose of inhibiting an exchange rate pass-through.

The relationship between monetary and fiscal policies has been increasingly studied, both in national and international literature. The volume edited by Chrystal (1998) is a good reference, as it compiles articles presented at the Bank of England's seminar on the theme. Dornbusch (1998) is among the pioneers who stated that public debt management may jeopardize the efficiency of monetary policy. He proposes that debt stock and, notably, debt structure may turn consumption into a positive function of the basic interest rate. In case public debt holders retain a substantial portion of the short-term debt, a raise in interest rates generates an increase in income that, in turn, can be translated into an increase in aggregate demand. In that case, the efficiency of monetary policy is affected. Bell-Keaton and Ballinger (2005) present a post-Keynesian perspective on the theme. They also provide evidence that, in countries highly indebted, interest rates and the GDP are positively correlated.

The great participation of floating Treasury bonds indexed to Selic (known as LFTs) in the total debt stock[xxi] may create a detrimental transmission channel in monetary policy, or a *financial wealth effect in reverse*, as proposed by Dornbusch (1998). In that case, a raise in the basic interest rate would increase aggregate demand, bumping prices. Based on that premise, Parreiras (2007) includes the relationship between federal domestic debt and the GDP in his estimate of BCB's reaction function.[xxii] Pires (2008) also addresses the interaction between monetary and fiscal policies in Brazil and provides evidence that "the wealth effect might explain part of the inefficiency of Brazil's monetary policy" (Pires, 2008: 25, our translation).

The extensive literature addressing that issue indicates that BCB may react to fiscal variables, thus justifying the inclusion of the debt/GDP relationship in the estimated model.[xxiii] The intuition pointing to the existence of a positive relationship between the debt stock and Selic is simple. In face of a deterioration in the National Treasury's ability to make payments – caused by an increase in debt – the agents tend to demand higher interest rates, in order to continue absorbing the offer of government bonds.

4.1 Costs and Benefits of Monetary Policy

Figure 3 shows the response of variables *DInd, DDebt, DIPCA, DExchange* to a shock (of a standard deviation and according to the Cholesky Decomposition) in *DSelic*, and thus allows to analyze the effect of a raise in the basic interest rate on the other variables included in the model.

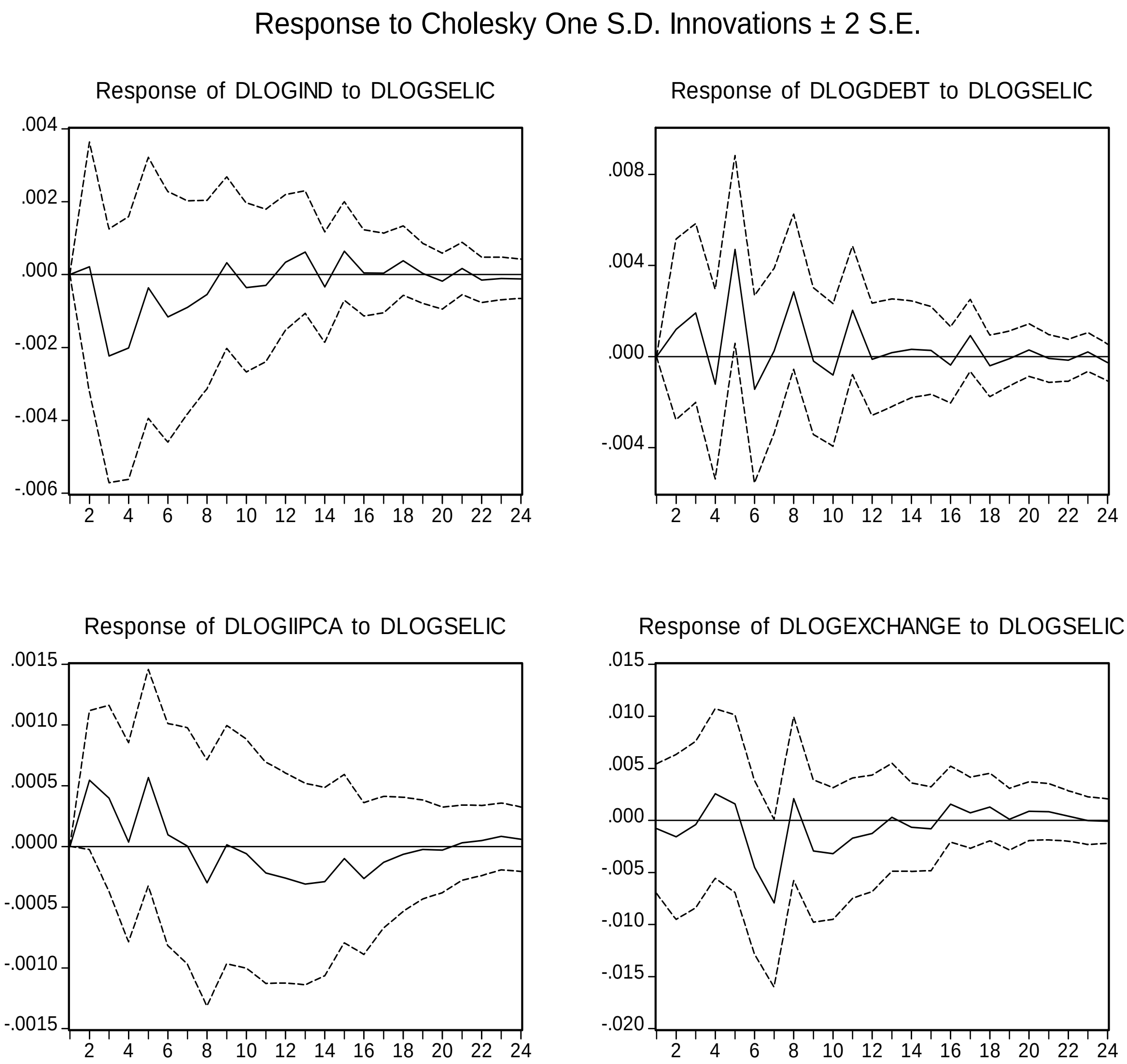
The *DIPCA's* response to a shock in *DSelic* constitutes a typical price-puzzle situation (Walsh, 2003: chap. 1). Initially, inflation accelerates, peaking out in, respectively, two and five months, and then declines, reaching a minimum in 12 to 14 months. After that, inflation accelerates again and, finally, the effect dissipates in about 18 months.

That behavior, though not backed by orthodox theory, has become a sort of rule in VAR models (Eichenbaum, 1992). Such phenomena have also been verified in Brazilian economy by Luporini (2007) for example. The most conventional explanation for that behavior is that it is due to a problem of misspecification: the variables included in the model do not cover the whole package of information at BCB's disposal (Sims, 1992). Based on that premise, Christiano *et al.* (1996) and Sims and Zha (1998) eliminated the puzzle by introducing a commodity price index.

An alternative motivation, which has gained relevance lately, is that there is a *cost channel* in the transmission of monetary policy. In other words, a raise in interest rates increases production costs of firms which – depending on their market power and demand conditions – can be transferred into prices. Such view is based on Kalecki's (1978) contribution, who considers that prices are determined by a mark up rule over production costs. A post-Keynesian approach to inflation costs is found in Palley (1996: chap. 11) and Arestis (1992: chap. 6), for example.[xxiv] Podkaminer (1998) develops a theoretical model in which the maintenance of interest rates at a sufficiently high level is enough to generate inflationary pressures.

In accordance with this literature, a monetary contraction prompts, at first, an increase in costs that is quickly transmitted to prices. Later on, a raise in interest rates slows down economic activity and, finally, produces a negative impact on inflation. Therefore, the puzzle might result from a mismatch between the effects of monetary policy on production costs – which are more immediate – and its lagged impacts on aggregate demand and, finally, on prices.

Figure 3 – Response of *DIPCA*, *DInd*, *DExchange* and *DDebt* to *DSelic*



Gaiotti and Sechchi (2006), based on data provided by 2000 Italian companies, found evidence in support of the existence of cost channels. Barth and Ramey (2000) arrived at the same conclusion regarding the American economy. One should also see Hannsgen (2006) for that matter. On the importance of such a channel in the Brazilian economy, see Marques and Fochezatto (2006).

More than the occurrence of a *price puzzle*, it is the inflation low sensitivity to interest rates that has drawn our attention. In that sense, the benefit – in terms of lowering inflation – of a raise in the basic interest rate proves to be quite small (and of little statistical significance).

The effect of a raise in the basic interest rate on industrial output (as a proxy of GDP) is negative, despite being of little statistical significance.[xxv] A shock in *DSelic* causes *DInd* to fall (though in an erratic manner), reaching a minimum within three months. From that point on, industrial output recovers, the effect of the shock wanes off after about ten months and clears out completely in 20 months. Therefore, the final effect of a shock in interest rates on industrial output is negative.

Exchange rate increases in reaction to a shock in the basic interest rate. Initially, *DExchange* accelerates marginally. After the fourth period it begins to decline, reaching a minimum in seven months. After that, *DExchange* slowly increases and the effect of the shock is completely dissipated after 21 months. The final result of a *DSelic* shock on *DExchange* is also negative – that is, exchange rate appreciates in response to an increase in the basic interest rate.

Finally, debt increases in response to a raise in interest rates. The impact of a shock in *DSelic* peaks out in five months. From that point on, *DDebt* begins to decrease, though in a very erratic manner, and the effect wanes off in about 12 months. The final effect of a shock in *DSelic* on *DDebt* is clearly positive – that is, the debt/GDP relationship increases.

Table 9 shows a measure of a monetary policy shock, based on a cumulative response of a Selic shock (at the end of *n* months) on industrial output, debt/GDP ratio, IPCA and exchange rate.[xxvi]

Table 9 – Cumulative Responses to Selic Innovations

Months	*DInd*	*DDebt*	*DIPCA*	*DExchange*
6	-9.57%	8.90%	2.82%	-5.36%
9	-9.97%	12.06%	2.03%	-17.76%
12	-11.09%	14.53%	1.30%	-28.56%
18	-10.12%	18.17%	-0.61%	-28.14%
24	-10.14%	16.91%	-0.29%	-22.86%

At the end of 24 months, a raise of 1% in Selic results in: i) a decrease of 10.14% in *DInd*; ii) an increase of 16.91% in *DDebt*; iii) a fall of 0.29% in *DIPCA*; and iv) a raise of 22.86% in *DExchange*. Once again, our attention is drawn to inflation's low sensitivity to interest rates: the final effect of a monetary contraction on IPCA is negative, though very limited in magnitude. Notwithstanding, the cumulative impact of a raise in Selic on the other variables is not negligible.

In sum, the empirical evidence shows us, on the one hand, that a given raise in Selic produces a relatively small benefit – measured by the consequent reduction of inflation; and, on the other hand, shows that it generates costs which should not be underestimated, specially a slowdown in economic activity and an increase in the debt/GDP ratio. Besides that, a rise in interest rates causes domestic currency to appreciate in a way that jeopardizes the competitiveness of domestic industry and, as a result, deteriorates external accounts and slows down economic activity even further (Bresser-Pereira, 2010a; 2010b). So, monetary policy has been imposing a heavy burden on Brazil's economy, as the cost of reducing inflation can be considered high.

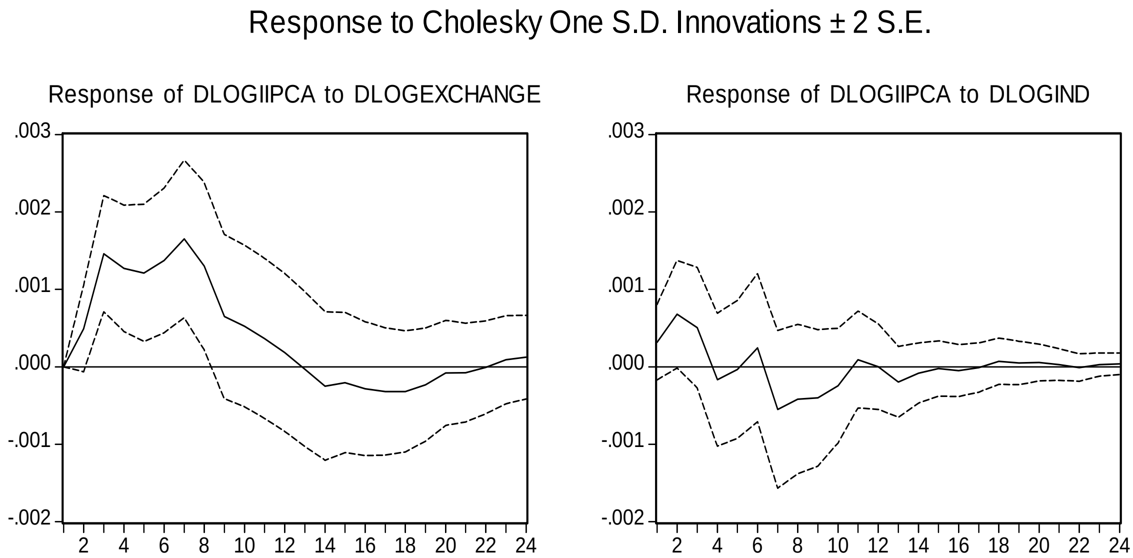
Inflation's low sensitivity to interest rates can be interpreted, at least in part, as a result of a broken transmission mechanism: flaws in the transmission of monetary policy are one of the factors that reduce its efficiency (Modenesi and Modenesi, 2012). Consequently, maintaining price stability under IT *requires* setting the basic interest rate at relatively high levels. Thus, it is fair to argue that the occurrence of flaws in the transmission mechanism makes for a less favorable balance of costs and benefits in monetary policy.

4.2 – Transmission of Monetary Policy

Figure 4 presents *DIPCA* response to a shock in *DExchange* and in *DInd* (by a standard deviation and according to Cholesky decomposition). It shows how the effects of monetary policy are transmitted to inflation.

Inflation rates accelerate immediately after a shock in *DExchange*, peaking out after seven months. From that point on, inflation slows down gradually, with shock effects in *DExchange* dissipating only after more than 12 months. The impulse-response function only stabilizes after 22 to 24 months. It is worth mentioning that exchange rate depreciation is transferred into prices and its inflationary effect is considerably persistent: a year after the shock in *DExchange*, inflation is still above the initial level.

Figure 4 – Response of *DIPCA* to *DExchange* and *DInd*

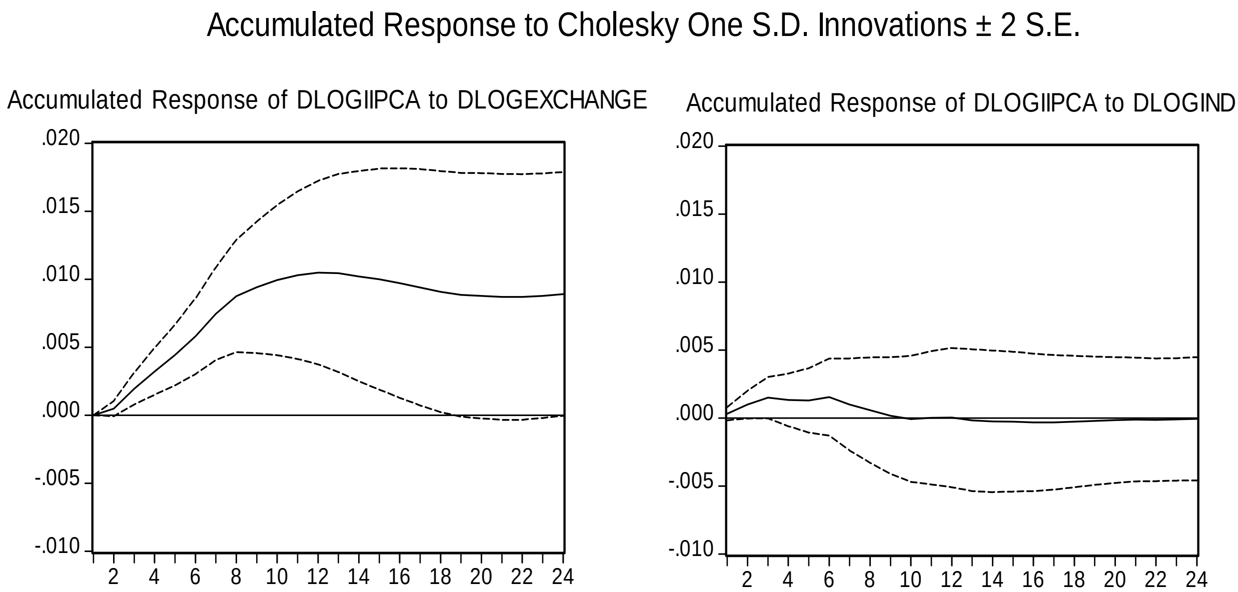


Conversely, inflation's response to an increase in the level of economic activity (measured by industrial output) is practically null. Inflation accelerates and peaks out in the second month after the shock in *DInd*. From the third month onwards, it slows down (in an erratic manner) and by the tenth month after the shock the effect ceases.

On the one hand, the fact that, in general, part of the increase in industry output is translated into an increase in business investment could explain that behavior. A greater amount of investment reflects on the expansion of aggregate supply which, in turn, has a negative impact on the general price level. In sum, the inflationary effect of a higher level of economic activity – measured by industrial output – is almost negligible. That means that inflation does not follow the business cycle.

On the other hand, one might argue that such a result is a consequence, at least in part, of industrial activity not being a good proxy of GDP. The share of industry in GDP is around 30%, so it might be an unreliable proxy of GDP. Notwithstanding, it is reasonable to suppose that, on average, there is a positive correlation of the level of activity between the primary, secondary and tertiary sectors. But they can also, at certain moments, show diverging, sometimes even conflicting behaviors.[xxvii] In face of that, a monthly indicator that gives a more accurate picture of GDP is needed. It is worth noting that, even so, the industry GDP is largely applied as a proxy of GDP in Brazilian literature – since those variables are highly correlated. Figure 5 shows the cumulative effects of a shock in *DExchange* and in *DInd* on IPCA.

Figure 5 – Cumulative Response of *DIPCA* to *DExchange* and *DInd*



4.3 The Relevance of the Exchange Rate Channel

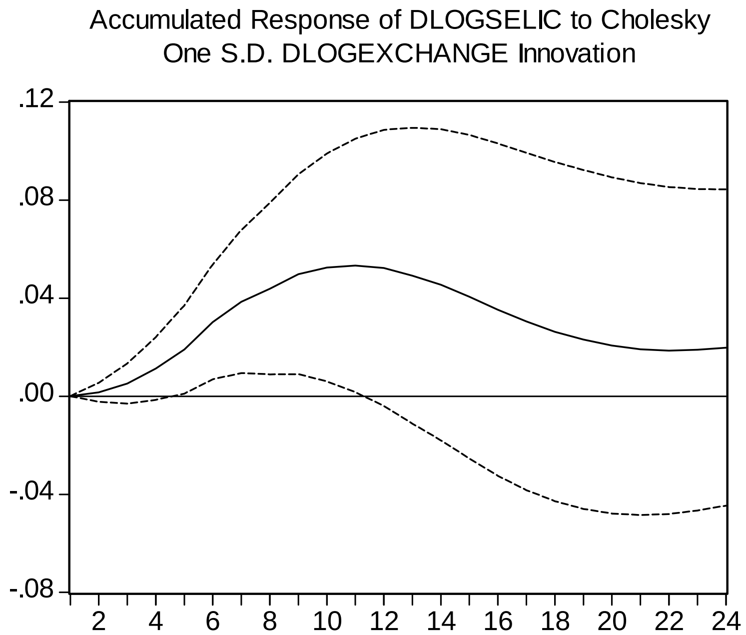
In previous sections we discussed that a rise (fall) in *DExchange* determines a rise (fall) in *DIPCA* and that a rise (fall) in *DSelic* prompts a rise (fall) in *DExchange*. Furthermore, *DExchange* causes *DIPCA* and also *DSelic*, in the Granger sense (Table 5). The combination of those empirical relationships makes for a passive monetary policy.

One can reasonably assume that BCB is aware that variations in exchange rate precede in time changes in inflation. Thus, in face of an exchange rate depreciation – with a view to hold down the consequent pass-through to prices –, monetary authority raises the basic interest rate. The following diagram illustrates the essence of the monetary policy operation in the time frame in question:

$$\uparrow Exchange_t \Rightarrow \begin{cases} \uparrow IPCA_{t+1} \\ \uparrow Selic_{t+1} \rightarrow \downarrow Exchange_{t+2} \rightarrow \downarrow IPCA_{t+3} \end{cases}$$

Figure 6 shows the cumulative response of *DSelic* to a shock in *DExchange* (by a standard deviation and according to the Cholesky decomposition). Right after the shock, *DSelic* is raised, and the accumulated effect peaks out by the tenth month after the shock. From there onwards, *DSelic* falls, with the shock effects clearing out after 20 months. It is, therefore, one more piece of evidence that, in face of an exchange rate depreciation, BCB raises the basic interest rate.

Figure 6 – Cumulative Response of *DSelic* to *DExchange*



As discussed before, monetary policy in Brazil is reasonably passive: BCB has reduced autonomy to determine the basic interest rate, which responds to variations in exchange rate – given the relevance of that channel in the transmission mechanism of monetary policy. In fact, the importance of exchange rate in the transmission mechanism has been noted in other works, such as Kregel (2004), Serrano (2006), Oreiro *et al.* (2008) and Serrano and Summa (2011). [xxviii]

As a consequence, exchange rate appreciation cannot be considered an undesired byproduct of setting the interest rate at a high level, as many point out. On the contrary, empirical evidence shows that this is the essence of the current stabilization policy: a rise in Selic appreciates Brazilian real. Given the importance of exchange rate in the evolution of IPCA, an appreciation of real reduces inflation. This piece of evidence, together with the others already presented, reveals that the exchange rate is the main transmission mechanism of monetary policy.

Table 10 presents *DIPCA* variance decomposition, which reinforces the importance of exchange rate in defining inflation behavior. *DIPCA* variance is to a great extent explained by the variance in *DExchange*: at the end of 12 months, the evolution of exchange rate explains nearly a half (45%) of inflation's behavior, which confirms the importance of exchange rate in the transmission mechanism of monetary policy. By contrast, the economic activity explains only 6% of *DIPCA* variance. In other words, the analysis of variance decomposition reinforces the results obtained by impulse-response functions (Figures 3, 4, 5) presented in previous sections.

Table 10 – Variance Decomposition of *DIPCA*

Period	S.E.	*DInd*	*DDebt*	*DIPCA*	*DSelic*	*DExchange*
3	0.016666	6.657372	1.204679	69.07535	3.703791	19.35881
6	0.017662	4.422845	14.02493	41.86110	3.836597	35.85453
9	0.018199	5.668733	14.17741	32.17434	3.217717	44.76180
12	0.018381	5.760120	14.05483	31.48954	3.554980	45.14053

Cholesky Ordering: DSelic, DIPCA, DInd, DDebt, DExchange.

Table 11 shows the variance decomposition of *DSelic*. It also corroborates the importance of exchange rate in determining the basic interest rate. *DSelic* variance is to a great extent explained by *DExchange* variance: at the end of 12 months about 30% of the basic interest rate behavior is explained by the exchange rate evolution.

Table 11 – Variance Decomposition of *DSelic*

Period	S.E.	*DInd*	*DDebt*	*DIPCA*	*DSelic*	*DExchange*
3	0.016666	2.735550	13.27749	2.056785	79.66592	2.264252
6	0.017662	4.154006	17.10794	2.539432	56.19791	20.00071
9	0.018199	4.209698	17.01129	3.434756	49.25619	26.08807
12	0.018381	4.148671	16.79445	5.162524	48.03867	25.85569

Cholesky Ordering: DSelic, DIPCA, DInd, DDebt, DExchange.

In sum, the evidence suggests that the exchange rate has been the main channel of monetary policy transmission: in face of an inflationary surge, BCB raises the basic interest rate with a view to appreciate the currency (real) and thus curb prices. Therefore, the exchange rate appreciation is not an undesirable result of monetary policy, but the essence of inflation control.

5 Conclusions

We have performed a sufficiently robust econometric analysis of monetary policy transmission mechanism. The results of such analysis are a broad body of evidence which allows us to evaluate the main costs and benefits of the stabilization policy adopted in Brazil since 2000.

The exchange rate has proven to be the main channel of monetary policy transmission. Appreciation of real cannot be considered an undesirable byproduct of interest rate fixation at high levels. On the contrary, empirical evidence reveals the essence of Brazilian current stabilization policy: Selic high rate appreciates the real. Given the importance of exchange rate in the evolution of prices, exchange rate appreciation reduces inflation.

Empirical evidence also shows that inflation's sensitivity to interest rates is low. On the one hand, a raise in Selic rate generates a relatively small benefit – as measured by the consequent decrease in inflation. On the other hand, an interest rate rise produces considerable costs, notably when it causes economic activity to slow down and the debt/GDP ratio to increase. Furthermore, a raise in Selic leads to an appreciation of the real which, whilst undermining the competitiveness of domestic industries tends to deteriorate external accounts and jeopardize economic activity. One should note that monetary policy imposes a great sacrifice on Brazilian economy: the cost of reducing inflation is considerably high.

Inflation's low sensitivity to interest rates can be interpreted as resulting, at least in part, from a broken transmission mechanism: flaws in the transmission mechanism of monetary policy contribute to reduce its efficiency. Price stability under IT thus *requires* an excessively rigid monetary policy. The final result is, on the one hand, that inflation hardly gives in. We conclude that the balance of costs and benefits of price stability under IT is unfavorable.

Finally we must acknowledge that our results still need to be furthered. The body of evidence presented, though robust, needs to be improved. Therefore, a note of caution is warranted concerning the conclusions herein presented: in face of the importance of the consequences involved, further studies are still called for.

6 References

ABEL, A. B. (1997), “Comment on ‘The costs and benefits of going from low inflation to price stability’ by Martin Feldstein”. In: C. D. ROMER e D. H. ROMER, (Eds.), *Reducing Inflation : Motivation and Strategy*. Chicago: University of Chicago Press.

AKERLOF, G., DICKENS, W. e PERRY, G. (1996), “The Macroeconomics of Low Inflation”. *Brookings Papers on Economic Activity*, 1.

ANDRADE, J.P. e MORAES, J.F.M. (2005), “Como a dívida pública afeta a política monetária ótima?”. Secretaria do Tesouro Nacional, *XIX Prêmio do Tesouro Nacional*.

ARAÚJO, E. e LEITE, M. V. C. (2008), “Sobreapreciação cambial no Brasil: estimativa, causas e conseqüências (1994-2008)”. Instituto de Pesquisa Econômica Aplicada, *Texto para Discussão* (no prelo).

AREOSA, M e AREOSA, W. (2006) “The inequality channel of monetary transmission”. Banco Central do Brasil, *Working Paper Series*, 114, Agosto.

ARESTIS, P. (1992), *The Post-Keynesian approach to economics: an alternative analysis of economic theory and policy*. Vermont: Edward Elgar.

ARESTIS, P. and G. CHORTAREAS. (2006), “Monetary policy in the euro area.” *Journal of Post Keynesian Economics* 28 (3), pp. 371-94.

______. (2007), “Natural equilibrium real interest rate estimates and monetary policy design”. *Journal of Post Keynesian Economics* 29 (4), pp. 621-43.

BACHA, E. (1994), “O Fisco e a Inflação: uma interpretação do caso brasileiro”. *Revista de Economia Política*, v. 14 (1).

BACHA, E. (1995), “Plano Real: Uma Avaliação Preliminar”. *Revista do BNDES*, nº 3, junho.

BAILEY, M. J., (1956), “Welfare cost of inflationary finance”. *Journal of Political Economy*, 64, pp. 93-110.

BAKHSHI, H., HALDANE, A.G. e HATCH, N. (1998), "Some costs and benefits of price stability in the United Kingdom”. National Bureau of Economic Research, *NBER Working Paper*, July 1998, n. 6660.

BALL, L. (1993), ‘”What determines the sacrifice ratio?”. National Bureau of Economic Research, *NBER Working Paper Series*, 4306, Março.

BARBOSA, F. H. (2005a), “The contagion effect of public debt on monetary policy: The Brazilian experience”. *Ensaios Econômicos EPGE*, 591.

BARBOSA, F. H. (2005b), “O mistério da taxa real de juros”. *Conjuntura Econômica*, vol. 59 (11), p.13.

BARRO, R. J. e GORDON, D. B. (1983a), “Rules discretion and reputation in a model of monetary policy”, *Journal of Monetary Economics*, Julho.

BARRO, R. J. e GORDON, D. B. (1983b), “A positive theory of monetary policy in a natural-rate model”. *Journal of Political Economy*, v. 91 (4), Agosto.

BARTH III, M. J. & RAMEY, V. A. (2000). "The Cost Channel of Monetary Transmission". National Bureau of Economic Research, *NBER Working Papers* 7675.

BELAISCH, A. (2003), Exchange rate pass-through in Brazil. *IMF*, Working Papers, no 141.

BELL-KEATON, S. e BALLINGER, R. (2005), “The monetary policy outcomes curve: can the size and structure of public debt undermine policy objectives?”. In: P. ARESTIS, BADDELEY, M. e McCOMBIE, J. (Eds.), *The New Monetary Policy. Implications and Relevance*. Cheltenham: Edward Elgar.

BERNANKE, B. S. (2007), “Inflation Expectations and Inflation Forecasting”. *Monetary Economics Workshop of the National Bureau of Economic Research*. Cambridge (Mass.), July 10.

BERNANKE, B. S. e MISHKIN, F. S. (1997), “Inflation targeting: A new framework for monetary policy?”. National Bureau of Economic Research, *NBER Working Paper*, 5893, Janeiro.

BERNANKE, B. S., LAUBACH, T., MISHKIN, F. S. e POSEN, A. S. (1999), *Inflation Targeting: Lessons from the International Experience*. Princeton: Princeton University Press.

BEVILAQUA, A.S. e GARCIA, M.G.P. (2002), "Debt management in Brazil: Evaluation of the real plan and challenges ahead". *International Journal of Finance and Economics*, 7, pp. 15-35.

BLANCHARD, O. (2004), "Fiscal dominance and inflation targeting: lessons from Brazil". National Bureau of Economic Research, *NBER Working Paper*, 10389, Cambridge.

BLANCHARD, O.; DELL'ARICCIA; MAURO, P. (2010), "Rethinking Macroeconomic Policy". *Journal of Money, Credit and Banking*, V. 42 (6), pp. 199-215.

BLINDER, A. (1987), *Hard Heads. Soft hearts: Though-Minded Economics for a Jus Society*. Reading (Ma): Addison-Wesley.

BOGDANSKI, J., TOMBINI, A. A. e WERLANG, S. R. C. (2000), *Implementing Inflation Target in Brazil*. Banco Central do Brasil, *Working Paper* nº 1.

BRAUNSTEIN, E. and HEINTZ, J. (2009), "The gendered political economy of inflation targeting: assessing its impact on unemployment". In: EPSTEIN, G. and YELDAN, E. (Ed.), *Beyond Inflation Targeting: Assessing the Impacts and Policy Alternatives*. Cheltenham: Edward Elgar.

BRESSER-PEREIRA, L. C. (2010a), A tendência à sobreapreciação da taxa de câmbio no Brasil. In *Crise Global e o Brasil*, Rio de Janeiro: Editora FGV, 2010. pp: 127-151.

_______. (2010b), *Doença holandesa e indústria* (org.) Rio de Janeiro: Editora FGV.

BRESSER-PEREIRA, L. C. e NAKANO, Y. (2002). "Uma Estratégia de Desenvolvimento com Estabilidade". *Revista de Economia Política*, v. 22, n. 3, pp. 146-180, jul./set.

BUITER, W. H. e GRAFE, C.(2001), "No pain, no gain? The simple analytics of efficient disinflation in open economies". Mimeo. *European Bank for Reconstruction and Development*, Setembro.

BULLARD, J. B. e RUSSELL, S. (2004), "How costly is sustained low inflation for the U.S. economy". *Federal Reserve Bank of St. Louis Review*, v.86 (3), pp.35-67, Maio-Junho.

CALVO, G. (1978), “On the time consistency of optimal policy in the monetary economy”. *Econometrica*, v. 46 (6), November, pp. 1411-28.

CARNEIRO, F. G. (1997), "A metodologia dos testes de causalidade em economia". Departamento de Economia, UnB, *Série Textos Didáticos* n. 20. Brasília.

CARVALHO, F.J.C (2005), “Controles de capitais: uma agenda de pesquisa”. In: J. SICSÚ e F. FERRARI FILHO (Eds.), *Câmbio e Controles de Capitais*. Rio de Janeiro: Campus-Elsevier.

CHRYSTAL, K.A. (Ed.) (1998), *Government Debt Structure and Monetary Conditions*. London: Bank of England.

COOLEY, T. F. e HANSEN, G. D. (1989), “The inflation tax in a real business cycle model”. *American Economic Review*, v.79 (4), pp. 733-748, Setembro.

CORREA, A. S. e MINELLA, A. (2006), “Nonlinear mechanism of the exchange rate pass-through: A Phillips curve model with threshold for Brazil”. Banco Central do Brasil, *Working Paper Series*, 122, Brasília, Novembro.

CHRISTIANO, L.; EICHENBAUM, M.; EVANS, C. L. (1996), “The Effects of monetary policy shocks: evidence from the flow of funds”. *Review of Economics and Statistics*, vol. 78 (1), pp.16-34.

CYSNE, R. P. (2003), “Divisia index, inflation and welfare”. *Journal of Money, Credit and Banking*, v.35 (2), pp. 221-239, Abril.

DAVIDSON, P. (1978). *Money and the Real World*. London: Macmillan.

_______. (2003). *Post Keynesian Macroeconomic Theory*. Cheltenham: Edward Elgar.

DORNBUSH, R. (1998), “Debt and monetary policy: The policy issues”. In: G. CALVO e M. KING (Eds.), *The debt Burden and its Consequences for Monetary Policy*’. London: Macmillan e International economic Association.

DOTSEY, M. e IRELAND, P. (1996), “The welfare cost of inflation in general equilibrium”. *Journal of Economics*, v.37 (1), pp. 29-47, Fevereiro.

EICHENBAUM, M. (1992), “Comment on interpreting the macroeconomic time series facts: the effects of monetary policy”. *European Economic Review*, vol. 36 (5), pp.1001-11.

EICHENGREEN, B; EL-ERIAN, M.; FRAGA, A.; ITO, A.; PISANY-FERRY, J.; PRASSAD, E.; RAJAN, R.; RAMOS, M.; REINHART, C.; REY, H..; RODRIK, D.; ROGOFF, K.; SHIN, H.S.; VELASCO, A.; DI MAURO, B. W.; YU, Y. (2011), "Rethinking Central Banking". *The Committee on International and Policy Reform*, September.

ELLIOTT, G., ROTHENBERG, T.J. e STOCK, J.H. (1996). "Efficient tests for an autoregressive unit root". *Econometrica*, 64, pp.813-836.

EPSTEIN, G. (2000), "Myth, mendacity and mischief in the theory and practice of central banking. *Mimeo*. University of Massachusetts, Amherst.

_________. (2003), "Alternative to inflation targeting monetary policy for stable and egalitarian growth: a brief research summary". *Political Economy Research Institute Working Paper*, n. 62.

EPSTEIN, G. and SCHOR, J. (1990), "Macropolicy in the rise and fall of the golden age". In: S. Marglin and J. Schor (Eds.), *The Golden Age of Capitalism: Reinterpreting the Postwar Experience*". Oxford: Clarendon Press, pp. 126-52.

EPSTEIN, G. and YELDAN, E. (Ed.) (2009), *Beyond Inflation Targeting: Assessing the Impacts and Policy Alternatives*. Cheltenham: Edward Elgar.

ERBER, F. (2008a), "Development projects and growth under finance domination – the case of Brazil during the Lula years (2003-2007)". *Reviue Tiers Monde*, 194 (no prelo).

ERBER, F. (2008b) "The Evolution of Development Conventions". Instituto de Economia, Universidade Federal do Rio de Janeiro. *XII ISS Conference*, Rio de Janeiro, Julho.

ERBER, F. (2008c), "As convenções de desenvolvimento no Brasil: um ensaio de economia política". In: Anais do *5º Fórum de Economia da FGV-SP*, São Paulo (SP).

FAVA, A. C. P. e ROCHA, F. (2003), "Custos de bem-estar da inflação no Brasil: uma comparação das estimativas de equilíbrio parcial e geral". *Economia Aplicada*, v.7(3), pp. 461-490.

FELDSTEIN, M. (1979), "The Welfare Cost of Permanent Inflation and Optimal Short-Run Economic Policy", *Journal of Political Economy*, Vol. 87 (4), pp. 749-768.

FELDSTEIN, M. (1980), "The welfare cost of permanent inflation and optimal short-run economic policy". National Bureau of Economic Research, *NBER Working Paper*, 201, Maio.

FELDSTEIN, M. (1997), "The costs and benefits of going from low inflation to price stability". National Bureau of Economic Research, *NBER Working Paper*, 5469, Agosto.

FISCHER, S. (1993), "The Role of Macroeconomic Factors in Growth". *NBER Working Paper*, 4565, Dezembro.

FISCHER, S. (1995), "Central bank independence revisited". *The American Economic Review*, v. 85 (2), p. 201-206, Maio.

FREITAS, A. L. (2006), "Uma interpretação heterodoxa para as relações de taxa de juros, câmbio e inflação no Brasil, 1999-2006". Universidade Federal do Rio de Janeiro, Instituto de Economia, *Dissertação de Mestrado*, Setembro.

FRIEDMAN, M. (1948), "A monetary and fiscal framework for economic stability". *The American Economic review*, v. XXXVIII (3), pp. 245-264.

FRIEDMAN, M. (1956), "The quantity theory of money – a restatement". In: M FRIEDMAN (Ed.), *Studies in the Quantity Theory of Money*. Chicago: Chicago University Press.

FRIEDMAN, M. (1968), "The role of monetary policy". *The American Economic review*, v. LVIII (1), pp. 1-17.

GAIOTTI, E e SECCHI, A. (2006). "Is There a Cost Channel of Monetary Policy Transmission? An Investigation into the Pricing Behavior of 2,000 Firms". *Journal of Money, Credit, and Banking,* Vol. 38(8), pp. 2013-2037, Dezembro.

GARCIA, M. G. P. (2002), "Public Debt Management, Monetary Policy And Financial Institutions". PUC-RIO, mimeografado.

GILMAN, M. (1993), "The welfare cost of inflation in a cash-in-advance economy with costly credit". *Journal of Monetary Economics*, v.31, pp. 97-115.

GILMAN, M. (1995), "Comparing partial and general equilibrium estimates of the welfare cost of inflation". *Contemporany Economic Policy*, v. XIII, pp.60-71, Outubro.

GOLDFAJN, I. e WERLANG S. R. C. (2000), "The pass-through from depreciation to inflation: A panel study". Banco Central do Brasil, *Working Paper Series,* 5, Brasília, Setembro.

GOMME, P. (1993), "Money and growth revisited: Measuring the costs of inflation in an endogenous growth model". *Journal of Monetary Economics,* v.32(1), pp. 51-77, Maio.

GORDON, R. J. e KING, S. R. (1982), "The output cost of disinflation in traditional and vector autoregressive models". *Brooking Papers on Economic Activity,* 1, pp. 205-242.

GRANGER, C. W. J. (1969). "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods". *Econometrica*, 37, pp. 424–438.

GUTIÉRREZ, C. E. C.; SOUZA R. C. e GUILLÉN, O. T. C. (2007), "Selection of optimal lag length in cointegrated VAR models with weak form of common cyclical features". Banco Central do Brasil, *Working Paper Series, 139,* Brasília, Junho.

HAMILTON, J. D. (1994), *Time series analysis*. Princeton University Press,

HANNSGEN, G. (2006), "Gibson's Paradox II". *Levy Economics Institute Working Paper No. 448,* Maio.

HAIGHT, A.D. (2007), "A Keynesian angle for the Taylor rule: mortgage rates, monthly payment illusion, and the scarecrow effect of inflation." *Journal of Post Keynesian Economics* 30 (2), pp. 259-77.

HASLAG, J. S. (1994), "The effects of monetary policy in a model with reserve requirements". Federal Reserve Bank of Dallas, *Working Paper* 15.

HERRERA, S. (2005), "Policy mix, public debt management and fiscal rules: Lesson from the 2002 Brazilian crisis". World Bank Policy Research, *Working Paper* 3512.

HUMPHREY, T. M. (1986) *Essays on inflation*. Federal Reserve Bank of Richmond. Fifth Edition. Janeiro.

IMROHOROGLU, A. e PRESCOTT, E. C. (1991), "Evaluating the welfare effects of alternative monetary arrangements". Federal Reserve Bank of Minneapolis *Quarterly Review,* v.15(3), pp.3-10.

JONES, L. E. e MANUELLI, R. E. (1995), "Growth and the effects of inflation". *Journal of Economic Dynamics and Control,* v.18 (8), pp. 1405-1428, Novembro.

KALECKI, M. (1978), "Teoria da Dinâmica Econômica". In: P. Singer (org.) *Keynes/Kalecki*. Coleção Os Pensadores. São Paulo: Abril Cultural.

KREGEL, J. (2004). "Comment on Fernando Cardim de Carvalho – Monetary policy, monetary theory, and financial structure". *Econômica*, v. 6, n. 2, pp. 341-8.

KYDLAND, F. e PRESCOTT, E. (1977), "Rules rather than discretion: the inconsistency of optimal plans". *Journal of Political Economy*, 85, pp. 473-92.

KWIATKOWSKI, D., PHILLIPS, P.C.B., SCHMIDT, P. e SHIN, Y. (1992), "Testing the null hypothesis of stationary against the alternative of a unit root". *Journal of Econometrics*, 54, pp. 159-178.

LACKER, J. e SCHREFT, S. L. (1996), "Money and credit as means of payments". *Journal of Monetary Economics*, v.38(1), pp.3-23, Agosto.

LAUGHLIN, J. (1909), "Gold and Prices". *Journal of Political Economy,* 17, pp.257-271.

LAUGHLIN, J. (1911), "Causes of the changes in prices since 1986." *American Economic Review*, Proc., 1, pp.26-36, April.

LIMA, L. A. O. (2008), "Metas inflacionárias: a análise convencional e um modelo alternativo". *Revista de Economia Política*, v. 28 (2), pp. 187-206, abril-junho.

LUCAS, R. E. (1972), "Expectations and the neutrality of money". *Journal of Economic Theory*, pp. 103-124, Abril.

LUCAS, R. E. (1973), "Some international evidence on output-inflation trade-off". *The American Economic Review*, v. 63 (3), p. 326-334.

LUCAS, R. E. (2000), "Inflation and welfare". *Econometrica*, Vol. 68 (2), pp. 247-274, Março.

LUPORINI, V. (2007), "The monetary transmission mechanism in Brazil: evidence from a VAR analysis". *Estudos Econômicos*, 28 (1), pp. 7-30.

MADDALA, G.S., KIM, I.M. (1998), *Unit Roots, Cointegration and Structural Change*. Cambridge (UK): Cambridge university press.

MARQUES, A. M. ; FOCHEZATTO, A. (2006). *Importância do canal do custo na transmissão dos efeitos da taxa de juros sobre os preços na economia brasileira, 1994-2005*. In: XI Encontro Nacional de Economia Política, 2006, Vitória/ES. Anais do XI Encontro Nacional de Economia Política (SEP), 2006.

MATTOS, C. (2005), "Aspecto teóricos da dívida pública: aplicações para o Brasil". In: F. Mendonça (Org.), *A dívida pública brasileira. Brasília: Plenarium*, pp. 21-70.

MIHAILOV, A. (2006), "Operational independence, inflation targeting, and UK monetary policy." *Journal of Post Keynesian Economics* 28, no. 3: 395-421.

MISHKIN, F. S. (1999), "International experiences with different monetary policy regimes". National Bureau Economics Reseach, *NBER Working Paper*, 7044, Março.

MISHKIN, F. S. (2000), "Inflation targeting in emerging market countries". National Bureau Economics Reseach, *NBER Working Paper*, 7681, Março.

MISHKIN, F. S. e POSEN, A. S. (1997), "Inflation targeting: Lesson from four countries". Federal Reserve of New York, *Economic Policy Review*, v. 3 (3), pp. 9-110.

MODENESI, A.M. (2005), *Regimes Monetários: Teoria e a Experiência do Real*. Barueri: Manole.

MODENESI, A. M. & MODENESI, R.L. (2012), "Quinze Anos de Rigidez Monetária no Brasil: uma agenda de pesquisa". *Revista de Economia Política*, V. 32 (3), pp. 389-411.

MODENESI, A.M.; MARTINS, N.M.; & MODENESI, R.L. (2012). "A Modified Taylor Rule for the Brazilian Economy: convention and conservatism in 11 years of inflation targeting (2000-2010)". *Journal of Post Keynesian Economics* [to be published].

NAKANO, Y. (2005), "O regime monetário, a dívida pública e a alta taxa de juros". *Conjuntura Econômica*, vol. 59 (11), pp.1.

NEPONUCEMO, E.M. (2005), "Gestão da dívida pública pré-fixada no regime de metas de inflação brasileiro". *Dissertação de Mestrado*, FGV, Rio de Janeiro.

NOGUEIRA JR, R. P. (2007), "Inflation targeting and exchange rate pass-through". *Economia Aplicada*, São Paulo, v.11 (2), pp. 189-208, Abril-Junho.

NORONHA, L. E. P. (2007), "O canal cambial de transmissão da política monetária no regime de metas de inflação no Brasil". Universidade Federal do Rio de Janeiro, Instituto de Economia, *Dissertação de Mestrado*, Novembro.

OKUN, A. M. (1978), "Efficient disinflation policies". *American Economic Review*, v.68, pp. 348-352, Maio.

OREIRO, J. L.; PUNZO, L.; ARAÚJO, E. e SQUEFF, G (2008), "Restrições Macroeconomias ao Crescimento da Economia Brasileira num Contexto de *Perfect Storm*: diagnósticos e algumas proposições de política". *5º Fórum de Economia de São Paulo*, EESP/FGV-SP.

PALLEY, T. I. (1996), *Post Keynesian Economics*. Nova York: St. Martin's.

PARREIRAS, M.A. (2007), "A estrutura institucional da dívida pública brasileira e seus impactos sobre a gestão da política monetária: uma análise empírica do regime de metas para a inflação". *Dissertação de mestrado*, USP, São Paulo.

PASTORE, A. C. (1997), "Senhoriagem e inflação: o caso brasileiro". *Texto para Discussão EPGE/CERES*, 5, Setembro.

PHELPS, E. (1967), "Phillips curves, expectations of inflation and optimal unemployment over time". *Economica*, August.

PHELPS, E. (1968), "Money wage dynamics and labour-market equilibrium". *Journal of Political Economy*, v. 76 (2), pp. 678-711.

PIRES, M.C. (2008), "Interação entre política monetária e fiscal no Brasil em modelos robustos a pequenas amostras". *Tese de doutorado*, UNB, Brasília.

PODKAMINER, L. (1998), "Inflationary effects of high nominal interest rates". *Journal of Post Keynesian Economics*, Vol. 20(4), pp. 583.

ROSSI, J. W. (2003), "O Custo de bem-estar da inflação: cálculo tentativo com o uso de um modelo de equilíbrio geral". *Estudos Econômicos*, São Paulo, v.38 (1), pp.127-150, Janeiro-Março.

ROSSI, J. W. (2008), "'Shoe-leather' costs of inflation: Some estimates for Brazil". *Economia Aplicada*, São Paulo, v.7 (3), pp. 439-459.

SARGENT, T. (1981), “Rational Expectations, the real rate of interest, and the natural rate of unemployment”. In: R. LUCAS e T. SARGENT (Eds.), *Rational Expectations and Econometric Practice*. Mineapolis: The University of Minnesota Press.

SARGENT, T. e WALLACE, N. (1981a), “Rational expectations and the theory of economic policy”. In: R. LUCAS e T. SARGENT (Eds.), *Rational Expectations and Econometric Practice*. Mineapolis: The University of Minnesota Press.

SARGENT, T. e WALLACE, N. (1981b), “‘Rational’ expectations, the optimal monetary instrument, and the optimal money supply rule”. In: R. LUCAS e T. SARGENT (Eds.), *Rational Expectations and Econometric Practice*. Mineapolis: The University of Minnesota Press.

SERRANO, F. (2006). “Taxa de juros, taxa de câmbio e metas de inflação”. *Valor Econômico*, 24/03, p. A-23.

SERRANO, F. e SUMMA, R. (2011). “Macroeconomic Policy, Growth and Income Distribution in the Brazilian Economy in the 2000s”.
Center for Economic and Policy Research, June.

SIMS, C. (1992), “Interpreting the macroeconomic time series facts: the effects of monetary policy”. *European economic Review,* v. 36(5), pp. 975-1000.

SIMS, C. e ZHA, T. (1998), “Does monetary policy generate recessions?”. Federal Reserve Bank of Atlanta, *Working Paper 12.*

SINN, H-W. (1999), “Inflation and welfare: Comment on Robert Lucas”. National Bureau of Economic Research, *NBER Working Paper*, 6979, Fevereiro.

SHILLER, Robert J. (1996), "Why Do people dislike inflation?". National Bureau of Economic Research, *NBER Working Paper*, 5539, Abril.

TÖDER, K. H. e ZEIBARTH, G. (1997), “Price stability VS. low inflation in Germany: An analysis of costs and benefits”. National Bureau of Economic Research, *NBER Working Paper Series,* 6170, Setembro.

TOOKE, T. (1983), “*A History of prices, and the state of the circulation, from 1793 to 1837”*. London: Printed for Longman, Orme, Brown, Green, and Longman’s.

US CONGRESS (1995), *Economic Growth and Price stability Act.*

VERNENGO, M. (2007). “Money and inflation”. In: P. Arestis and M. Sawyer (Eds.), *A Handbook of Alternative Monetary Economics*. Cheltenham: Edward Elgar.

______. (2008). “The Political Economy of Monetary Institutions in Brazil: The Limits of the Inflation-targeting Strategy, 1999-2005”. *Review of Political Economy*, V. 20 (1), pp. 95-110.

WALSH, C. (2003), *Monetary Theory and Policy*. Cambridge (Ma): MIT Press.

[i] In Brazil, the basic interest rate goes by the acronym (Selic) for Sistema Especial de Liquidação e de Custódia (Special System for Settlement and Custody), the settlement system for most domestic securities of Brazilian central government.

[ii] See Okun (1978) and Gordon and King (1982). Blinder (1987) applies this concept to the deflation operated by Paul Volcker in the period between 1980 and 1984. Ball (1993) studies 65 episodes of deflation in OECD member countries, between 1960 and 1990. See also Tödter and Zeibarth (1997) and Buiter and Grafe (2001).

[iii] See Bernanke and Mishkin (1997), Mishkin and Posen (1997), Bernanke *et al.* (1999) and Mishkin (1999; 2000).

[iv] It is not this paper's intention to make an exhaustive exposition on the IT. For more details see Modenesi (2005: cap. 3), who discusses the advantages and disadvantages of IT and its theoretical foundations. See also Lima (2008).

[v] For instance, we may say that for most Post Keynesians using the interest rate to fight inflation is deemed problematic. For instance, fighting cost push inflation by managing aggregate demand is inadequate, since it affects only the symptoms, instead of the causes of that kind of inflation (Davidson, 1978; 2003). See also Vernengo (2007; 2008) and the book edited by Epstein and Yeldan (2009), according to whom: "modern central banking ought to have more policy space in balancing out various objectives and instruments. In particular, employment creation, poverty reduction and more rapid economic growth should join inflation stabilization and stabilization more generally as key goals of central bank policy" (p. 7).

[vi] Arestis and Chortareas (2006, 2007), and Mihailov (2006) present a critical appraisal on Taylor rule. Haight (2008) presents a Post Keynesian critique of the so called *Taylor principle* –

the proposition that interest rates should always be raised (reduced) proportionally more than a given rise (fall) in inflation rate.

[vii] See also Mishkin and Posen (1997) and Modenesi (2005: chapters 2 and 3).

[viii] The vast literature available on the theme also includes: Feldstein (1979, 1980, 1997), Cooley and Hansen (1989), Imrohoroglu and Prescott (1991), Gomme (1993), Gilman (1993; 1995), Haslag (1994), Jones and Manueli (1995), Dotsey and Ireland (1996), Lacker and Schreft (1996), Akerlof, Dickens and Perry (1996), Shiller (1996), Bakshi and Abel (1997), Haldane and Hatch (1998), Sinn (1999), Cysne (2003), Rossi (2003), Bullard and Russel (2004). On the Brazilian case, see Pastore (1997), Fava and Rocha (2003) and Rossi (2008), among others.

[ix] It is worth noting that, according to Bacha (1994; 1995), this was not a problem in pre-Real Brazil. On the contrary, whereas tax revenue was indexed, expenses were not, generating a *reverse Tanzi* effect.

[x] As expressed in the 1995 North American *Economic Growth and Price Stability Act*: "[B]ecause price stability leads to the lowest possible interest rates and is a key condition to maintaining the highest possible levels of productivity, real incomes, living standards, employment, and global competitiveness, price stability should be the primary long term goal(…)" (US Congress, 1995).

[xi] See Epstein and Schor (1990) and Epstein (2000) for a political economy perspective on monetary policy-making.

[xii] A raise in Selic increases the debt stock in two manners: i) directly, considering that a significant portion of the debt is composed of floating Treasury bonds (known as LFTs), indexed to Selic; and ii) indirectly, given that, upon a raise in Selic, bond demanders tend to require higher returns in order to buy pre-fixed bonds.

[xiii] Indeed there are many others problems with IT. For instance, Braunstein and Heintz (2009) investigate "gender-specific impacts of policy responses during inflation reduction episodes" (p. 110).

[xiv] Bernanke (2007) postulates that: “price stability(...) is a good thing in itself” and “in the long term, low inflation promotes growth, efficiency and stability – which, all else being equal, support maximum sustainable employment” (pp. 1-2).

[xv] See Hamilton (1994, chapter 17).

[xvi] This is the normal procedure, commonly found in literature; for example, Luporini (2007) uses eight lags.

[xvii] The order chosen for the VAR model is: *Selic*, *IPCA*, *IND*, *DIV* and *Exchange*. *SELIC* was chosen as the most exogenous variable, since it is the instrument of monetary policy and (as a rule) is adjusted only eight times per year at COPOM meetings. The exchange rate was chosen as the most endogenous variable, given that through the expectations channel, it can be affected contemporaneously by all other variables. Inflation contemporaneously affects *DEBT* because a portion of debt stock is indexed to *IPCA*. It is more difficult to justify the effect of inflation on GDP; however, Table 5 shows that *IPCA* precedes *IND*. Identifying the ordering of variables by means of Granger causality test might not be appropriate in principle. Cholesky ordering indicates a contemporary causality between the variables, whereas Granger indicates a temporal precedence. However, Granger can be used as a method to sort the variables within Cholesky ordering, considering that there is a positive correlation between Granger causality probability and contemporary causality. *DEBT* is affected contemporaneously by *SELIC* and *IPCA* because debt stock is in part indexed to *IPCA* (NTN-B) and in part to *SELIC* (LFT). The contemporary effect of *IND* on *DEBT* can be explained by *DEBT* being the ratio Debt/GDP.

[xviii] Accordingly, as the size of the sample of any given variable increases, the sample distribution average will tend to normal.

[xix] According to the BCB reports of 2002 and 2009, the percentage of exchange-rate-indexed public bonds added up to 28.6% in 2001; 22.4%, in 2002 and 0.7%, in 2009.

[xx] For a review of the Taylor rule, see Modenesi *et al.* (2012).

[xxi] During the period, LFT amounts from nearly a half to more than one third of the total debt stock.

[xxii] It is worth noting that the author does not prove the existence of such a mechanism in Brazilian economy.

[xxiii] On this subject, see Garcia (2002), Bevilaqua and Garcia (2002), Blanchard (2004), Andrade and Moraes (2005), Barbosa (2005a; 2005b), Herrera (2005), Mattos (2005), Nakano (2005) and Neponucemo (2005).

[xxiv] For a historical perspective, see Humphrey (1986). Tooke (1838) and Laughlin (1909; 1911) are among the precursors of this conception.

[xxv] Since a negative relationship between GDP and interest rate is widely supported by literature, this little significance might be in part a result from industrial production not being such a good proxy of GDP (more details on page 15-6).

[xxvi] Belaisch (2003) uses this methodology to estimate the impact of exchange-rate depreciation on inflation in Brazil.

[xxvii] For example, the inventory cycle makes the industrial sector's activity level more volatile than the service sector.

[xxviii] Goldfajn and Werlang (2000), Correa and Minela (2006) and Nogueira Jr. (2007) estimate the exchange rate pass-through coefficient for Brazilian economy.